The Balloonist and the Engineer:
Talking More Effectively with Non-Engineers

by **Alan S. Brown**

The ability to communicate technical information is an important part of nearly every engineer's job description. Clarity and precision are valued by anyone who has ever worked on a cross-disciplinary team or had to puzzle out a problem with customers, vendors, or partners. Yet explaining technical information to non-experts remains a hurdle for many engineers. A story circulating on the Internet (reprinted in blue, below) captures the difficulty.

This story underscores a fundamental truth about communicating technical information: It often involves two or more people separated by a common language. The engineer delivers extremely precise data. Another engineer would know how to use it, but to the manager it sounds like gibberish. He lacks the background—think of it as a map with latitude and longitude markings—to use her data. Her words fly right past him.

Beth Schachter, a principle in New York City-based Still Point Coaching & Consulting who teaches scientists to write, remembers similar problems while she was earning her Ph.D. "I was never very good at explaining what I was doing in molecular and cell biology to my mother, but that's what I should have been doing to learn how to talk to generalists," she recalls. "When you talk to your neighbor in the lab, you don't have to go through introductions or justifications, but, for a broader audience, those things are absolutely necessary."

She saw the point more clearly when she began covering scientific meetings. "You'd see researchers so close to their work that they would forget to introduce their topic. They'd immediately begin giving six-decimal details and lose their audience before they even got to the point of their presentation."

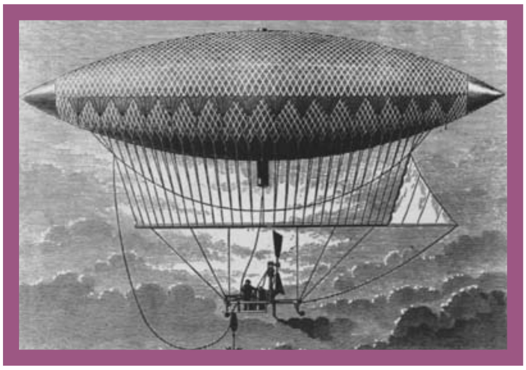
That's a problem because engineering, even more than science, has changed in ways that put a premium on communications.

A CHANGING PROFESSION

Engineering has long been a team effort. Yet today's teams are different. Often they cut across functions. They may include engineers from several disciplines, as well as marketers, manufacturers, administrators, and financial controllers. Teams may work closely with other corporate offices, key customers, development partners, and providers of outsourced services. While some team members are sleeping, others around the world are going to work.

Some team members understand your technology. Others do not. That means you must make technical points in a language everyone understands. Today's world puts a premium on engineers who write, talk, present, and email effectively in order to share, describe, convince, and motivate. Otherwise, how can your team buy into a project, decide between competing technologies, approve a budget, okay a timetable, or even sell a product's unique benefits.

No wonder communications has become a part of almost every engineering job description. According to a study by Pennsylvania State University's center for the study of higher education, 91 percent of businesses surveyed rated "communicate effectively" a "highly important" or "essential" skill for new engineering graduates. It rates even higher than "engineering problem solving" (86 percent) and "apply math, science, and engineering" (78 percent), the second and third most important skills.



Realizing he was lost, a balloonist dropped down to ask directions. "Excuse me, but I'm a little off course" he shouted. "I promised to meet a friend an hour ago, I don't know where I am."

A woman hollered back: "You're in a hot air balloon hovering approximately 30 feet above the ground. You're at exactly 40 degrees, 22 minutes, and 21 seconds North latitude and 70 degrees, 30 minutes, and 33 seconds West longitude."

"Amazing," the balloonist replied. "You must be an engineer!"

"I am," she replied, "How did you know?"

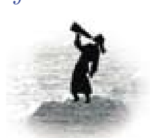
"Well," answered the balloonist, "everything you told me is technically correct, but I can't use your information. I'm still lost and you haven't been much help at all. If anything, you've delayed my trip."

The woman thought for a moment, then replied: "You must be in management."

"I am," replied the balloonist, "but how did you know?"

"Well," said the woman, "you don't know where you are or where you're going. You've risen to your position due to a large quantity of hot air. You made a promise that you have no idea how to keep, and you expect people beneath you to solve your problems."

"In fact," she said, "you're in exactly the same position you were before we met, but somehow it's now my fault."



Granted, nobody hires engineers who cannot solve problems or apply engineering skills. Perhaps the reason communications ranks so high is that employees are desperate for engineers who can drive their points across.

Many engineers agree with their employers. In 2001, the University of Michigan asked mechanical engineering alumni to rank the skills that helped them most in their careers. Design/creativity, math, physics, and computer know-how all ranked high. Yet none ranked higher than technical communications.

A 1995 survey of University of Idaho engineering graduates found that 40 percent wished they had learned more writing skills and 60 percent more oral presentation skills at college.

Not surprisingly then, ABET, Inc., the accreditation board for engineering and technology, added communications to its curriculum standards in 1996.

STRATEGY

There is no one way to learn to communicate. Engineering college writing and presentation courses vary widely. Many seek to engage students with assignments about famous inventions or such critical technological issues as nuclear power and climate-change factors. Others take a more paint-by-the-numbers approach, making sure students know what constitutes a solid engineering paper or presentation.

Both approaches are a step up from grade-school emphasis on spelling, grammar, and (eventually) organization. Yet most courses do not tackle the single most important issue in professional communications: strategy.

Engineers in business, academia, and government all communicate for a reason. You may want to fund a new project, update partners, or share research, but everyone has a purpose for communicating.

To achieve that goal, you must do more than shout out data to balloonists in the sky. You need to think strategically about the type of information your specific audience needs to hear.

Some may worry that this involves dumbing down information. And some communicators will undoubtedly need to simplify or eliminate non-essential data.

More importantly, though, you must also add information that helps your audience put your message into perspective. In other words, you must provide your balloonists with latitude and longitude markings so the information you give them makes sense.

A simple conceptual framework will help most engineers provide this type of map for their audience. It involves four steps:

- Define your goal.
- Know your audience.
- Put information (content) into perspective (context).
- Create mental maps that help guide your audience.

By using this framework, most engineers can immediately improve their ability to communicate strategically.

GOALS

Defining a purpose or goal is not as easy as it sounds. Yet the right definition will help define what to include or exclude from a presentation or paper. There are many reasons to present technical information. You might want to inform the public about new products, report on a project, describe a problem, explain a solution, recruit business partners, instruct technicians, or persuade someone to back your plan.

Your goal defines the structure of a presentation. If your goal is to define a technical problem, you need to describe the problem and its impact objectively. To persuade someone to use a particular technical fix, a mere description won't do. You need to explain why your solution is better than competing approaches.

Creating concrete goals—specific actions you want your audience to take—is critical to effective communications. Instead of launching a product, decide that people should come away knowing three reasons to use it. Instead of introducing a new technology, set a goal of having audience members set up meetings to talk about it.

Aiming at getting your audience to take a specific action keeps presentations focused. Most engineers are already experts in their field. There is no way they can fit everything they know into a short presentation or paper. If they try, they will overwhelm their audience. After all, if everything is as important as everything else, then nothing is more important than anything else. This is an easy way to leave audiences confused. The rule of thumb in achieving a goal is to eliminate any information that does not support it.

How does this work? Imagine you have 10 minutes to sell an audience on using a robot designed to work next to humans. You should explain how its low power, slow speed, and ability to stop on impact make it safe. You could describe how ease of programming and precision make it productive. Finally, you can show how customers use it to save time and money.

In this brief presentation, you don't have time to spell out overall design philosophy or materials of construction. You don't need to go into programming details or lay out the specifics of each potential application. At the end of 10 minutes, listeners should know whether they want to learn more or not.

AUDIENCE

A talk or paper should match the audience that will read or hear it. A highly technical paper that works fine at an engineering seminar will fall flat in a meeting of business executives or venture capitalists.

This is the problem that was faced by our engineer and balloonist. The engineer did not consider the balloonist's level of understanding. If she had said, "You're about four miles east of Princeton, NJ," she would have been less accurate, but the information would have been more useful to someone who had only a conventional road map.

To understand how organizations tailor messages to different audiences, consider a talk that Michael Wiltberger of OptiMedica Corp. gave at a National Instruments, Inc., seminar. Wiltberger is the principal engineer behind Pascal, a device that automates laser eye surgery for people with diabetic retinopathy.

At a gathering of engineers, Wiltberger discussed how National Instrument's LabView software let him quickly program Pascal's high-speed field-programmable gate-array controllers. In only a few months, he prototyped a device that makes 1,000 to 2,000 pinpoint laser burns on the retina in only a few minutes.

OptiMedica has a different type of message for doctors. It highlights clinical studies that prove Pascal is safe, effective, and less painful to patients. It shows a video of the operation to emphasize Pascal's speed and simplicity. The unit is so fast, it finishes the entire procedure in only a few minutes instead of the two or three sessions now required.

Potential investors are likely to hear a different story. They will learn that four-million people suffer from diabetic retinopathy. Conventional lasers are slow and often so painful that many patients do not complete treatments. Doctors will have an incentive to buy Pascal because it lets them finish (and bill for) the entire procedure in one session and also treat more patients. This ensures robust market demand. Although Pascal is a new product, it uses proven off-the-shelf technologies that have low risk.

OptiMedica's messages differ as much as its goal and its audiences. It explains how engineers can use LabView to speed prototype development. It shows doctors that Pascal is safe, easy to use, and profitable. It tells investors about potential rewards and low risks.

Unfortunately, engineers do not always have the luxury of sending a different message to each audience at a time. They often work on very inclusive teams. A new product might require mechanical, electrical, and optical engineers, as well as specialists in sensors, finite-element analysis, and new materials. Even in the earliest stages, the team might include market researchers, manufacturers, purchasers, and financial controllers. They may receive inputs from key customers, vendors, consultants, and outsourcing partners.

Can you talk to everyone in the room without talking down to the technology-savvy or losing the technology illiterate? There are two tools that can help you do this. The first is knowing how to use content and context. The second involves mental mapping, preparing your audience for what they are going to learn.

CONTENT AND CONTEXT

Everyone knows what content is: It is information, the stuff we get from newspapers, magazines, TV news, and the Internet. For engineers, content ranges from conceptual information and specifications to technical data, diagrams, and graphs.

The problem with content alone is that it makes sense only if we already know its context, the background that gives it meaning. To someone who follows a sports team, each event has meaning that goes beyond the news that is reported. A win affects the division race. A star's injury spells trouble. Increased playing time may mark the transition of a benchwarmer into a contributor. Because fans know their teams, they understand the significance behind the headlines.

The same is true when communicating technology. Engineers who know a technology are quick to appreciate its implications. A non-technical audience, on the other hand, may not understand the significance of a breakthrough without additional background information.

This means that communicators must learn to juggle content and context. They must provide enough background so that even non-technical professionals understand why the specifications or figures of merit are important. Generalists may not grasp every technical detail, but providing some background information will help them to understand why your main points are important.

How does this work in practice? Imagine that you want to sell a new type of bearing. You might describe competing systems. This sets the stage for showing how your bearing is different. You could discuss some of the problems with each system (such as wear or heat build-up) and how they are measured. This will let you quantify why your system is better. Finally, you might want to point to some specific applications where your bearing would shine.

This presentation balances specifications and data with background information. There are also ways to make the technical information more accessible for generalists. Pictures, for example, can show how heat and wear damage bearings. Graphs can put measurements into perspective. Charts can make comparisons more concrete.

Metaphors and similes also help people grasp difficult concepts. A simile is nothing more than a comparison: A car impact-absorption system deforms like an accordion. In melted plastics, the long molecules line up and flow like logs in a river.

A metaphor substitutes one object or idea for another. For example, cell phones operate much like people in a crowded bar. If you're in the back and want the bartender, you have to shout. And once you start shouting, the people in the front have to shout too, and they drown you out. When that happens with cell phones, the users farthest away cannot be heard over the din.

Another way to command attention is to share your enthusiasm by highlighting the most interesting aspects of a new technology. In other words, make them say "Oh, wow!" For example, note that a new turbofan jet engine is so light, you could walk into any gym in America and find a dozen men or women who could bench press it—or that a 50-inch high-definition television uses a fingernail-sized chip with one-million hinged mirrors to project its images. Or note that if you wanted to hack into industrial networks, you could find thousands of websites with instructions and even a video to describe how to build a wireless antenna.

By presenting technology in accessible ways and balancing content with context, it is possible to talk to a mixed audience and still keep everyone in the game.

MENTAL MAPPING

Anyone who has ever been a member of a debate team understands mental mapping. This is because the first rule of debating is to say what you are going to say (the introduction), say it (with details), and then say it again (conclusion).

The concept is simple: If people know where you are going—in a talk, memo, email, or paper—they will have an easier time following you there. Mental mapping is no more than drawing the big picture, then showing how each new piece of information relates to the picture.

This starts with a clear title. The title is the most widely read part of any paper or presentation. It should make a point. If grafting polymers onto nanotubes helps disperse them evenly in a polymer composite, why not call the presentation, "Grafting Polymers Enhances Nanotube Dispersion."

This title is clear, but only if the audience already knows that good dispersion improves polymer strength. A better title for a mixed audience might be, "Polymer Grafts Strengthen Nanotube Composites." This title tells the audience about the technology and a potential benefit. The point is obvious, even to those who know little about nanotubes, grafting, or composites.

Once you have made a statement in the title, follow up with introductory material that further explains your main point and puts it into context. In scientific and engineering papers, this is usually the abstract. After the title, it is the second most widely read part of any paper.

Most abstracts do a good job of explaining the technology. When it comes to grafting, a typical abstract might note the chemicals and technique used to make the graft, the improvement in dispersion, and how it enhances the final properties of the composite.

This is all useful information. Yet it fails to put this technical achievement into context. A better abstract might mention—even at the risk of removing some technical information—that poor dispersion has been a critical problem in using nanotubes in composites and that this new grafting process gives fabricators a flexible, economical way to put nanotubes to work in thermoplastics.

Now your audience knows where you are going. It knows the type of technical information you will present plus the reason that information is important. An introduction that puts content into context provides a good map for structuring the rest of the paper or presentation.

A technical paper for a journal has a defined structure that might include an introduction, experimental method, discussion, and conclusion. The introduction is the best place to provide details about the technical challenges, the reasons they are important, previous attempts to solve the problem, and why the new invention succeeds where others failed. The discussion should elaborate on experimental results and also make the technical case for the invention. The conclusion is the take-away—the main points a reader should remember.

Presentations and trade-journal articles do not have a predefined structure. Yet the beginning of a talk or article serves the same function as an abstract in a journal paper. It introduces the topic, puts it into context, and tells the audience where the article is going.

A good outline can help writers structure their papers and presentations. A simple, one-page outline that lists key points can show at a glance how the different sections connect with one another. It also lets writers double-check their logic. Sharing the outline with the audience in an introduction (or even showing the outline at the beginning of a presentation) keeps everyone oriented.

Think of each section in the outline as a mini paper or presentation in itself. Each segment should have a short introduction that puts it into context and maps where it is going. A section on grafting technology might discuss past problems with previous grafts and how the new method solves them. A discussion of experimental results might start by contrasting new and past results. A segment about a new technology's benefits might provide a summary, then the details of each benefit.

This model—starting with a meaningful title, introducing the topic broadly, and then providing details while constantly relating them to the overall point—is the same one used by journalists. Read an article in a newspaper or magazine, and you will see the same structure at work. By telling readers what the article is about, building one fact on top of the other, and adding enough content to keep readers tuned in, journalists can tell remarkably complex stories without losing their readers.

THE REAL EXPERTS

In the end, though, the engineer addressing an audience is the expert in his or her subject. It is the engineer's responsibility to make sure that the audience understands why the information is important.

Yet no engineer will ever have enough time to communicate everything he or she knows about a subject. Thinking strategically can help determine what information to communicate to whom.

To stay on track:

- Remember your purpose, and stick to it.
- Know your audience, and keep everyone involved.
- Put content in context with background information, pictures, graphs, and even similes and metaphors.
- Make us say, "Oh, wow!"
- Finally, show us where you are going so we can follow you easily.

Doing all these things will not necessarily make you an electrifying speaker, but it may provide just enough structure to help you get your point across.

Alan S. Brown has been an editor, contract editor, and freelance writer for more than 25 years and lives in Dayton, NJ (*insight@comcast.net*). A member of the National Association of Science Writers and co-chair of the Science Writers in New York, he graduated *magna cum laude* from New College at Hofstra University in 1974. He is an associate editor of *Mechanical Engineering,* contributes to a wide range of engineering and scientific publications, and teaches short courses to help engineers communicate more effectively.